Claims

1. A joint exothermic catalyst stage (2, 3) having at least one shift stage (2) for the catalytic conversion of a mixture of hydrogen, carbon monoxide and excess steam and also a fine purification stage (3) downstream of the shift stage (2) for the catalytic lowering of the residual carbon monoxide content of conversion products produced in the shift stage by selective methanization, wherein the shift stage (2) and the fine purification stage is configured as a unitary hollow body.

2. The exothermic catalyst stage as claimed in claim 1, wherein at least one shift catalyst which comprises at least one metal on a first support comprising a metal oxide selected from the group consisting of the metals of groups IB and VIIIB of the Periodic Table of the Elements, rhenium and cadmium is provided in the shift stage (2).

3. The exothermic catalyst stage as claimed in claim 2, wherein the metal oxide is cerium oxide and/or zirconium oxide.

4. The exothermic catalyst stage as claimed in claim 2 or 3, wherein the shift catalyst contains at least one transition metal promoter.

5. The exothermic catalyst stage as claimed in any of the preceding claims, wherein at least one methanization catalyst which comprises at least one metal which is able to form a metal carbonyl species on a second support is provided in the fine purification stage.

6. The exothermic catalyst stage as claimed in claim 5, wherein the metal is selected from the group consisting of ruthenium, rhodium, platinum, palladium, rhenium, nickel, iron, cobalt, lead, tin, silver, iridium, gold, copper, manganese, zinc, zirconium, molybdenum.

7. The exothermic catalyst stage as claimed in claim 5 or 6, wherein the second support is selected from among a crystalline aluminosilicate, aluminum oxide, cerium oxide, titanium oxide and combinations thereof.

8. The exothermic catalyst stage as claimed in any of the preceding claims, wherein the hollow body has a wall space for accommodating the shift catalyst and the methanization catalyst.

9. The exothermic catalyst stage as claimed in any of the preceding claims, wherein the wall space has a cross-sectional thickness which is from about 2 to 20% of the external diameter of the hollow body.

10. The exothermic catalyst stage as claimed in either claim 8 or 9, wherein flow channels are provided in the wall space.

11. The exothermic catalyst stage as claimed in claim 10, wherein perforations are provided between the flow channels.

12. The exothermic catalyst stage as claimed in either claim 10 or 11, wherein the flow channels are arranged essentially parallel to the longitudinal axis of the hollow body.

13. The exothermic catalyst stage as claimed in any of the preceding claims, wherein the hollow body has at least one central flow channel (5).

14. The exothermic catalyst stage as claimed in any of the preceding claims, wherein the joint exothermic catalyst stage (2, 3) comprises a flow feed housing (10) which surrounds it on the outside and through which a cooling medium flows in order to cool the catalyst stage.

15. A process for producing a joint exothermic catalyst stage as claimed in any of claims 1 to 14, which comprises the steps:

(a) provision of a hollow body;

(b) dipping of the hollow body into a suspension of a first support comprising a metal oxide over a first part of the length of the hollow body;

(c) fixing of the first support on the first part of the length of the hollow body so that a first coating is obtained;

(d) application of a metal to the first coating, with the metal being selected from the group consisting of the metals of groups IB and VIIIB of the Periodic Table of the Elements, rhenium and cadmium;

(e) application of a second support which comprises at least one metal which is able to form a metal carbonyl species to at least part of the length of the hollow body which is not covered by the first coating.

16. The process as claimed in claim 15, wherein the coating is calcined after application of the metal to the first coating.

17. The process as claimed in claim 15 or 16, wherein a calcination is carried out after application of the second support.

18. An apparatus for producing hydrogen, which comprises:

(a) a heated steam reforming stage (1) with a reforming catalyst to convert gaseous or vaporizable hydrocarbons and water into hydrogen, carbon monoxide and further reformer products;

(b) at least one shift stage (2) downstream of the steam reforming stage for the catalytic conversion of the mixture of hydrogen, carbon monoxide and excess steam leaving the steam reforming stage; and

(c) a fine purification stage (3) downstream of the at least one shift stage (2) for the catalytic lowering of the residual carbon monoxide content of the conversion products by selective methanization,

wherein the shift stage (2) and the fine purification stage (3) is configured as a joint exothermic catalyst stage (2, 3) as claimed in any of claims 1 to 14.

19. The apparatus as claimed in claim 18, wherein the heated steam reforming stage (1) is configured as a hollow body and comprises a burner (4) which is arranged centrally in the hollow cylinder of the reforming stage.

20. The apparatus as claimed in claim 18 or 19, wherein at least one indirect heat exchanger (6) is provided between the joint exothermic catalyst stage (2, 3) and the steam reforming stage (1) and the water required for steam reforming is passed through it in countercurrent to the gaseous products coming from the exothermic catalyst stage (2, 3).

21. The apparatus as claimed in any of claims 18 to 20, wherein the apparatus comprises only a single shift stage (2).